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ABSTRACT

Arguing that telecommunications is transforming almost every sector of American society except education, this study analyzed the governance, management, technical, and fiscal issues associated with the creation and maintenance of an education satellite telecommunications system that would make cost-effective, equitable access to quality education a reality for all American students. The first of six sections of this report reviews problems that impede greater use of satellites and fiscal and technical issues. The study process is described in the second section, including background information, the working groups, technical expertise, the conceptual approach, and the report and conclusions. Technical issues are considered in the third section, including alternative delivery systems, the education satellite market, program providers, assessment of existing earth stations, space segment configuration and deployment, technologies for transmission and reception, and financial considerations. The fourth section addresses government and management issues such as ownership of the satellite, governance of the system, models for governance, and technical management of satellites. Fiscal issues addressed in section five include financing the organization, financing the satellite with tax-exempt bonds, and other methods. General observations in section six conclude the report. The names and addresses of members of the two working groups--technical issues and policy and governance issues--are appended. (DB)

A DISCLAIMER

This report is offered to policymakers and the public as an analysis of various options available for the acquisition, governance, and management of one or more satellites dedicated to education. The findings of fact and any conclusions based on them are those of the EDSAT Institute and do not necessarily represent the official position of any of the organizations, businesses, governmental agencies and individuals who served as participants in the working groups.

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ANALYSIS OF A PROPOSAL
FOR AN
EDUCATION SATELLITE

The Edsat Institute

1025 Connecticut Avenue, N.W. Suite 506

Washington, D.C. 20036

1991

The EDSAT Institute is a non-profit tax exempt educational and research organization founded in 1988 to encourage the access and utilization of telecommunications in all forms throughout America's schools, colleges, universities and libraries. The Institute is supported through private gifts, grants, and contracts. The work of the Institute is conducted under the policy guidance of a 20 member Advisory Board.

The EDSAT Institute Advisory Board

ACKNOWLEDGEMENTS

In an endeavor such as this, there are many who deserve recognition and appreciation for their contributions. It is safe to say in this case, without the help of the following people this report would not have been written. A special recognition goes to the EDSAT Institute Advisory Board for its leadership, commitment and courage to address telecommunications and education issues which are essential as we prepare for the twenty-first century.

Our gratitude and thanks go to the Chairs of the Working Groups which provided valuable insight and information that shaped many aspects of this report. These outstanding leaders found time to Chair meetings of their respective groups in spite of very full calendars: Dr. Peter Likins, President of Lehigh University and a Director of COMSAT, Inc. who chaired the Technical Issues Group; and the Honorable Joseph Duffey, President of the University of Massachusetts System and the Honorable John H. Buchanan, Jr., Chairman of People for the American Way, who co-chaired the Policy and Governance Working Group. These three individuals made a great contribution to the productivity and success of the Working Groups.

Special thanks also go to the members of the Working Groups whose names appear in the Appendix to this Report. All of the participants in the Working Groups gave freely of their time. Their information, research, insights and contacts made an invaluable contribution to the analysis of issues addressed in this report.

We also are indebted to the expertise provided by the researchers: Philip Malet and Jerry Howe, partners with Steptoe and Johnson; Kevin DiLallo, attorney, and Grier Raclin, partner, Gardner, Carton and Douglas; and Frank Weaver, President and CEO of UNET, Inc.. They always were prepared and worked conscientiously under the pressure of very short time lines.

Jack Hannon, Vice President for Corporate Issues Management at COMSAT, Inc., must be placed in the category of "unsung hero." His institutional memory of the creation of COMSAT/INTELSAT was invaluable to our work. Through Mr. Hannon's good offices, COMSAT generously provided facilities and in-kind support to make the long, arduous working group meetings pleasant and comfortable. The EDSAT Institute is indebted and grateful.

Special thanks and gratitude are extended to Governor Wallace G. Wilkinson of Kentucky for the confidence he placed in the EDSAT Institute when he requested that this study be done in response to his call for the creation of a satellite dedicated to education. We trust that this report will provide the basis on which he and other state and federal policymakers can move forward to implement a satellite-based telecommunications system for education.

Special recognition is due the Honorable Jack D. Foster, Secretary of the Education and Humanities Cabinet in Kentucky, for his keen understanding of the issues and state policy. We express deep appreciation to Governor Wilkinson and the people of Kentucky for the generous contribution of time and effort put forth by Secretary Foster. His insights on public policy and personal commitment to the reform of American education can be found throughout our work and this report.

Last but not least, we extend great appreciation to Harlan Rosenzweig, President of Westinghouse Communications, Inc., for the sustained personal and financial support of the EDSAT Institute over several years which made this project possible.

ABOUT THIS REPORT

Telecommunications is transforming almost every sector of American society -- small business, manufacturing, commerce, communications, religion, transportation, banking, tourism, entertainment, health and defense. But not education. Our schools must undergo a transformation to :t the global challenges of the Information Age.

Standing in our way to th .ransformation are significant disparities in access to quality educational opportunities. Major differences exist in availability of qualified teachers in both urban inner city schools and remote rural schools. Telecommunications has the potential to make cost-effective, equitable access to quality education a reality for all American students without regard to their personal wealth or the wealth of their community or state.

Governor Wallace G. Wilkinson of Kentucky, along with other Governors of the states and territories, has raised the issue of a need for a public domain satellite dedicated to education. At the request of Governor Wilkinson, the EDSAT Institute undertook this analysis of the governance, management, technical and fiscal issues associated with creation and maintenance of an education satellite telecommunications system.

We embarked on this challenge with a view that the numerous stakeholders with different interests could be brought together to use their expertise and experience to develop realistic policies and options. The cooperation and participation of a large number of people from government, education, and the telecommunications industry, working with experts in telecommunications gave substance and direction to the analysis contained in this report. All of them shared a common desire to improve American education.

It was apparent throughout the project that the problems associated with an education satellite were not technical in nature. The central issues were how to finance and govern this resource in an equitable and efficient manner. The analysis presented in this report provides Governors, the Congress, federal and state officials, educators and the telecommunications industry feasible, equitable and cost-beneficial options for creating and maintaining an education satellite system.

Issues were raised during the project which deserve serious attention but were considered outside the scope of the present analysis. Among these are issues of program quality, teacher certification and training, improving interaction between students and teachers, and research on the effectiveness of various distance learning methodologies. It is hoped that the EDSAT Institute can address these issues in a similar manner in the near future.

I am pleased to submit this report as a resource for moving forward with the proposal to create an education satellite system for all levels of American education. Surely such a system can make a significant contribution toward our goal of equal opportunity to a quality education for everyone.

Shelly Weinstein, President
The EDSAT Institute

ANALYSIS OF A PROPOSAL FOR AN EDUCATION SATELLITE SYSTEM

TABLE OF CONTENTS

ANALYSIS OF A PROPOSAL FOR AN EDUCATION SATELLITE SYSTEM

1. INTRODUCTION

The crisis in American education is well documented. Although public education is a constitutional responsibility of the states, the consequences of a failed educational system affect the nation as a whole. America is moving rapidly from an industrial to an information and technology based economy in which only the educated will thrive. There is a great need to reach, educate, train and retrain an ever larger number of people of all ages with limited time and resources.

Not only is the quality of American education generally substandard, there also are significant differences from one community to another in the quality of the educational opportunity available. Disparity in wealth within and among the states has become a very troublesome problem as we pursue the national goal of providing equal access to a quality education in America. Ways must be found to provide high quality education and training to all Americans without regard to their personal wealth or the wealth of their locale or state.

Universal access to the rich educational resources of this great nation is possible in part through telecommunications. Although telecommunications has turned the world into a "global village," our schools for the most part remain relatively isolated enterprises. The encouraging news is that this situation is rapidly changing. Individual states are beginning to invest heavily in telecommunications technology as one approach to sharing educational resources.

The communication technologies through which these programs are delivered at the local level include optical fiber, coaxial cable, microwave and fixed-base broadcast television as well as receivers of satellite transmissions. Although all land-based technologies are essential to a complete telecommunications network, at the present time satellites are the best means by which to distribute multiple educational programs simultaneously to every part of a state or the nation at a relatively low unit cost.

Problems Which Impede Greater Use of Satellites

Schools and colleges find it difficult and costly to secure appropriate and predictable transponder time because of their inability to negotiate individual long-term commitments with satellite communication vendors. Likewise the satellite industry regards schools and colleges as "occasional users" which precludes their securing transponder time at the lower rates available for long-term contracts.

Purchasing an entire transponder by education agencies to ensure reliable time can triple or quadruple the effective transmission cost because this practice requires them to purchase substantial amounts of less desirable time. The effective cost of "prime" time under such circumstances turns out to be even more expensive than the high cost transient rates. Schools and colleges are forced to compete with business users even for the available transient time. Commercial buyers generally purchase transient time for business teleconferencing and major news agencies often purchase it to cover unexpected major news events. Both are willing to pay whatever is required under the circumstances, often driving the cost beyond the reach of education.

Another problem related to the availability of satellites is a projected shortage of transponder time. Industry experts indicate that new satellites are being launched with full or nearly full contract commitments. Some experts view the problem of limited transient transponder time as likely to become even tighter over the next decade. Contributing to this uncertainty is the impact of digital compressed video technology will have on satellite capacity. This dilemma underscores the unpredictability education purchasers of satellite time will face in the future.

It should be obvious that some education agencies are at a distinct disadvantage in such a competitive marketplace. The inability of education agencies to aggregate purchasing power means they end up paying unnecessarily high rates for satellite transmission. On the other hand, vendors must deal with multiple purchasers few of which by themselves are major consumers of their commodity. In the larger marketplace, education agencies do not represent at the present time a major market for satellite vendors. The bottom line problem is that states are expending as much as 40% more for transponder time than they would have to spend if there was a more efficient marketplace. Presently, there is no mechanism through which education agencies can aggregate their purchasing of transponder. Sound public policy dictates that we search for an alternative to competing for transponder time with commercial buyers.

The use of transient satellite time also means that our education broadcast stations have to find a vendor with available time. Satellite transmission requires precise telemetry. A change in vendor requires a reorientation of the uplink transmission facilities which in turn requires a corresponding reorientation of the downlink facilities. The effect is similar to having to place telephone calls through 20 or 30 different telephone companies each requiring a different telephone receiver. Existence of a single satellite source would eliminate most of the need for such technical adjustments at the school district or school site.

When commercial vendors market their programming to schools, some offer receivers oriented to their own satellite transmissions. This is tantamount to having different telephone companies selling unconnected telephone services to schools. As teachers decide to move from one program to another, they must reorient their satellite receivers. The problem could be greatly increased if commercial vendors were to shift their programs to the Broadcast Satellite Service (BSS) band which requires circular rather than linear polarization. The ground station equipment now in place in American public schools is based on C and Ku Band technology which is incompatible with BSS transmission polarization.

A Proposed Solution

The various technical, operational and fiscal problems described here are directly related to the nature of the satellite marketplace. Under the present system, the need for satellite vendors to ensure financial viability leaves schools, colleges and universities without predictable, low-cost and equitable access to satellite services. Creation of an educational satellite infrastructure is a tangible step toward mitigation of the equity and quality of education problems facing America's public schools. Such a telecommunications system could make possible extensive distribution of high quality educational programming to every school, college, university and library in the nation.

It is impractical for states, individually or collectively, to undertake the development of such a system without creative partnerships among the federal government, the private sector and themselves. The cost of the construction and launch of a Ku-C band satellite is estimated to be somewhere between $150 and $200 million. Additionally, annual operating costs for maintenance of the satellite can be several million dollars each year. Our analysis indicates that American taxpayers will pay at least $45.5 million this year alone to commercial vendors for satellite services. A similar investment in a dedicated satellite would return its initial cost in three to four years. Improved access to satellites would eliminate some of the problems that inhibit greater use of this technology for educational purposes and thereby stimulate further demand.

In response to these issues, the EDSAT Institute is reviewing the policy, governance, fiscal, operational and technical issues and options associated with development of a satellite-based telecommunications system dedicated to education.

2. THE STUDY PROCESS

The EDSAT Institute is a non-profit tax exempt educational and research organization founded in 1988 to encourage the access and utilization of telecommunications in all forms throughout America's schools, colleges, universities and libraries. The Institute is supported through private gifts, grants, and contracts. The work of the Institute is conducted under the policy guidance of a 20 member Advisory Board.

Governor Wallace Wilkinson (Kentucky) proposed to President George Bush at the Charlottesville Education Summit in 1989 that a public domain satellite dedicated to education be built and launched as a partnership effort between the states and the federal government. The EDSAT Institute agreed to review the relevant legal, fiscal, operational and policy issues and to recommend options for organizational structures to govern, manage and utilize a dedicated public education satellite system in a manner that would ensure its appropriate and equitable use.

The workplan described here was designed to directly involve representatives of the various stakeholders in this project such as the education community, various federal agencies, the Congress, the satellite and communications industry and other interested parties. Over the course of the study substantial interest in the concept was found among these groups. The EDSAT Institute is indebted to these groups and is grateful for the extensive amount of important information and assistance they provided. Their continued interest in the proposal remains high.

The Working Groups

The Institute sought to broaden the base of participation in the study by establishing two working groups made up of representatives of these stakeholders. A Technical Issues Working Group focused on the technical aspects of the proposal and was chaired by Dr. Peter Likins, President of Lehigh University and member of the Board of Directors of the COMSAT Corporation. The mission of this group was to respond to information prepared by the EDSAT Institute researchers regarding the technical attributes, orbital configuration and estimated cost to design, construct and launch a public domain satellite dedicated to education. Mr. Frank Weaver, CEO of UNET, Inc., an engineer and former satellite industry representative, coordinated research for the technical issues working group.

A Policy and Governance Working Group focused on the legal, fiscal and governance aspects of the proposal and was co-chaired by Dr. Joseph Duffey, President of the University of Massachusetts System, and Mr. John H. Buchanan, Jr., Chairman of People for the American Way and former Congressman from Alabama. The mission of this group was to respond to alternative approaches to the governance and management of one or more public domain satellites dedicated to instructional functions or activities to be used by educational institutions (preschool through graduate school) and adult learning programs. The research for this aspect of the project was provided by Grier Raclin, Partner, and Kevin DiLallo, attorneys with Gardner, Carton and Douglas and by Philip Malet and Jerry Howe, partners with Steptoe and Johnson. Both law firms are Washington-based with strong practices in telecommunications law.

The primary role of the working groups was to ensure that the researchers were responsive to the concerns of those entities which have a direct stake in the existence of a public domain satellite dedicated to education. The working groups met twice between October and December of 1990 to review and comment on the draft documents prepared by the consultants and offered valuable insights that guided the contents of this final report. Revisions and further research followed each session. The working group members gave a final review of this report in draft form in January 1991. The EDSAT Institute Advisory Board reviewed the draft report at a December 1990 meeting and provided editorial comment on the final report in February 1991.

The Conceptual Approach

There were several guiding principles followed in the conduct of the study. A public domain satellite system design had to satisfactorily meet these criteria:

Accessible	Reliable
Equitable	Timely
High Quality	Predictable
Acceptable to Users	Sufficient
Affordable	Compatible
Fundable	Fully Utilized
Effective	Flexible

The consultants were asked to advance only those proposals which would optimize attainment of these attributes.

The Report and Conclusions

This report is offered to policymakers and the public as an analysis of the various options available for the governance, management and acquisition of one or more satellites dedicated to education. The conclusions of fact and the recommendations based upon them are those of the EDSAT Institute and do not necessarily represent the official position of any of the organizations, businesses or governmental agencies who served as participants in the working groups.

3. TECHNICAL ISSUES

Several considerations were discussed in determining whether or not satellites should be used for the delivery of educational programming. A brief review of some of the available delivery systems was made to give a comparable assessment of their relative strengths and weaknesses.

Alternative Delivery Systems

A satellite has the capability to deliver a signal that can be received anywhere in its footprint which can cover all 50 states. That signal can be received by anyone with a satellite dish. Currently, there are several satellites in orbit with the capability to transmit educational programming and there will be no delay in waiting for a system to be built in order to begin transmission. In addition, satellites have a tremendous capacity to transmit several programs simultaneously. With the advent of digital video compression technology, up to 20 video programs may be transmitted over a single transponder at one time thereby enhancing the throughput of a satellite without having to spend one cent in redesigning or retrofitting the existing base of satellites in orbit. Through the use of very small aperture terminals (VSATS), it is possible to combine video, audio, and data with interactivity.

Of the 92 million U.S. television households (TVHH), 53 million or 57% subscribe to basic cable service. Not all households are passed by cable, because it is either not cost-efficient to lay the cable or areas are too sparsely populated to justify the investment. Oddly enough, satellites are being used to reach those homes inaccessible to cable. For example, K Prime Partners, which includes major cable programmers and operators, has just initiated a service to deliver cable type programming to those homes unserved by a ground cable. Hence, the obvious advantage of a satellite's ability to reach every household is demonstrated.

It should also be noted that satellites are used by cable programmers to deliver their programs to cable headends for distribution to an installed base of over 50 million TVHH. This fact should not be ignored in considering the importance of satellites in the delivery of educational programs provided there is available channel space on a particular cable system. Cable is limited in its throughput capacity. The average channel capacity of cable systems is 35 channels. This is scarcely enough to satisfy the voracious demand for entertainment and to offer capacity for educational programming.

Fiber optic cable has some advantages in that it has greater bandwidth capacity than coaxial cable, suffers lower losses of signal strength over distance, and is capable of interactivity. However, fiber is not available everywhere and it would be very costly to wire the nation with fiber. It is estimated that if the telephone companies were to wire the nation with fiber optic cable, it would cost between $500 and $900 billion and would take many years to complete.

Microwave and terrestrial broadcast television are the oldest technology and presently are the primary vehicle for instructional television. Although both are effective means of video distribution, they each have coverage and capacity limitations and they cannot compete with satellites for nationwide or even regional program coverage. No one delivery system is without any shortcoming, but satellite transmission is the most effective for satisfying the criteria stipulated in the preceding section. Satellites are also compatible with other delivery systems and can utilize the inherent advantage of each.

The Education Satellite Market

At least nine C-band satellites with 30 or more full time or occasional use transponders offer educational services. They are GE Satcom 3R and F1R, Hughes Westar 4 and 5, Hughes Galaxy 2 and 3, GTE Spacenet 1 and 2, and Telstar 301. At Ku-band, eight satellites providing 22 or more full time or occasional use transponders are used. They are GTE GSTAR 1 and 2, GTE Spacenet 1, 2, and 3, GE Satcom K1 and 2, and Hughes SBS 4.

As of October 31, 122 Ku-band transponders were operational on U.S. satellites. Of that amount, 111 are in use. The Ku-band transponder figures do not include 19 on SBS 6, launched on October 12, 1990, but already 16 of these have been leased for video entertainment services. GSTAR 4's 16 transponders, launched on November 20, 1990 are also not included. There were 384 C-band transponders operational for the same period. Of that total, 331 were in use. Not reflected in either of these numbers are the 24 transponders on each of Galaxy 6 and GE Satcom C1, launched October 12 and November 20, 1990 respectively. All of these satellites will become operational some time in 1991.

Some difference of opinion exists within the industry as to how much surplus capacity is going to be available to education in the 1990s. Industry estimates, based on planned launches in the early years of the decade, indicate that most vendors will have prelaunch contracts for most of the transponders available on new satellites. However, emerging technologies such as digital video compression technology could radically change the utilization of existing and future transponders and dramatically increase their capacity.

Present satellite providers probably will continue to have space for their current education clients. However, the EDSAT Institute could not determine how prepared the private marketplace will be to accommodate a rapid expansion in educational use. Our best estimate is that consolidation of educational programming on one or more satellites will result in some migration of present users from existing satellites to other inflight or new satellites in order to accommodate the present market. Presumably, lower cost reliable transponder time also would result in greater availability and utilization of satellite-based instruction.

Program Providers

At least 111 providers of educational programming delivered by satellite have been identified. A study compiled by Kentucky Educational Television of 20 of the larger providers revealed that they expect to purchase more than 75,000 hours of transponder time during the 1990-91 school year. If the prime broadcast time is 12 hours, taking into consideration time zone differences, for five days a week over 36 weeks which is the typical school year, these 20 agencies would *average* 2,160 hours per year utilization of at least 35 transponders *during the designated time frames*.

The KET study did not indicate the hours, days or weeks during which these transponder hours would be used so the exact utilization of a dedicated satellite by these 20 education agencies could not be determined. However, if one assumes a satellite has 24 transponders, then just these 20 program providers conceivably could utilize nearly 73 percent of the capacity of two satellites during the prime 12 hour, 5 day, 36 week broadcast period. Obviously, there could be considerable underutilization of these same transponders during the remaining hours, days and weeks by some users. A cost efficient use of a dedicated satellite system obviously will require the development of imaginative educational programming targeted to nontraditional students, other educational uses of excess time, or the sale of unused time to non-education users.

Given that the 20 agencies identified in the KET study only represent about eighteen percent of the 111 purchasers identified by the EDSAT Institute, one can see that the probable demand for transponder time will be much greater than pictured in the KET study. Many other agencies also will seek time on an education satellite, although we could not document how much it might be. The point being made here is that education represents a significant market right now. The problem does not seem to be demand as much as the lack of coordination in purchasing satellite time so as to gain maximum economic benefit from such a large expenditure.

Assessment of Existing Earth Stations

A minimum of 55,000 receive sites of educational telecommunications have been identified. This figure does not include business television for training. There are about 125,000 school buildings, grades K-12 in the country. There are also 3,000 colleges and universities and 6,000 libraries. Little data are available about the installed based of receivers of satellite signals by schools, colleges and libraries. What is knows probably represents only a portion of the actual installed based. Here is what we found.

In a Fall 1990 Quality of Education study, it is reported that 2,336 (16%) of the nation's 15,000 school districts have satellite dishes. Seen another way, 19,201 (23%) of the schools in these districts have satellite dishes. One earlier study of school districts with satellite dishes identified that 68% are C-band, 40% are Ku-band, 7% are C and Ku-band, and 84% are steerable. In addition, there are over 3 million home satellite dish owners, mostly at C-band. Due to the mix of earth stations operating at both C and Ku-bands, any satellite servicing them should offer dual frequency capability.

The size of these earth stations varies from about 2.5m to 10m (or about 8 to 30 feet) in diameter. There is a strong desire by program providers to offer broadcast quality reception, hence a somewhat larger dish is required to receive the weaker signal from some of the older C-band satellites. The use of higher power Ku-band transponders brings down the size of the earth station to about 1.2m (or 4 feet). Most dishes are mounted on the ground so as to minimize problems of having to reinforce roof structures to withstand the weight and wind loading conditions imposed by these dishes.

Although no actual cost figures are available from educational telecommunications users, it is known that earth station equipment costs, including installation, can range from about $2,500 to $30,000 or more. This figure is exclusive of the costs of peripherals such as monitors, phone lines, video cassette recorders, personal computers, or linking the dish to several locations around a site. A more complete survey of the universe of ground stations used to receive educational programming is in progress.

Space Segment Configuration and Deployment

When one looks at the universe of satellites being used for educational telecommunications, both C and Ku-band satellites are being utilized. Hence, any satellite(s) providing service must offer capability at both frequency bands. If one were to aggregate the users on one satellite, it should be a hybrid. It may also be desirable to provide cross-strapping of C and Ku-band transponders on-board the satellite. In other words, one could uplink at C-band and the satellite would convert the frequency to downlink at Ku-band in addition to being able to receive an uplink at Ku and downlink at C-band. This capability would make it possible to access the large number of C-band dishes at cable headends and at private households plus the growing number of Ku-band dishes. It should be noted that the FCC will require full frequency reuse of both bands on a single satellite in order to maximize the use of limited orbital slots.

Hybrid satellites such as GTE Spacenet 1, 2, 3 and Contel ASC offer full frequency reuse at C-band but not at Ku-band. Because of the increased demand for satellite capacity and the limit of spectrum, the FCC has determined that these designs are no longer an efficient use of an orbital slot. Because instructional programs originate from and are received in all 50 states, it is necessary for the satellite to have CONUS uplink capability so that the location of any program provider or receiver is not restricted.

A few comments on the relationship of satellite power to dish size are necessary. Generally speaking, the higher the power on the satellite, the smaller the dish and that implies lower cost of earth station equipment and installation. The current on-orbit C-band satellites operate between 5 and 16 watts, and the Ku-band satellites between 20 and 45 watts. Future trends are towards putting even more power on the satellite at both frequency bands.

The highest power satellites being proposed (from 100 to 200 watts) are the direct broadcast satellites operating in the Broadcast Satellite Service (BSS) band with an uplink at 17 Ghz and a downlink at 12 Ghz. It is anticipated that reception of a high quality signal can be achieved with a 13 inch flat plate antenna or a similar size parabolic dish. It should be noted that the circular polarization scheme in the BSS band differs from the linear polarization in the Fixed Satellite Service (FSS) band of existing satellites and earth stations. To achieve compatibility, the existing universe of dishes must be retrofitted or replaced to receive signals in the BSS band. In any event, none of these new BSS birds will be launched and operational before 1994.

Ironically, new satellite systems in the FSS band are offering higher power at Ku-band at 60 watts and at 120 watts by combining the output of two 60 watt travelling wave tubes. AT&T's Telstar 4, due for launch between late 1993 to early 1994, will provide this capability. Other replacement satellite systems may also offer similar power levels. Since they will operate at the same frequencies and polarizations that are currently in use, there will be no compatibility issue. Satellites that service the educational telecommunications market today and for the near future should operate at both C and Ku-bands in the Fixed Satellite Service. BSS could be used to augment program offerings when it comes into existence but not to replace the systems currently in orbit.

Technologies for Transmission and Reception

Digital video compression can help to increase the use of transponders by allowing more than one video program to be transmitted simultaneously over a single transponder. Some estimates range as high as up to 20 video signals per transponder. At present, no compression service of more than eight signals per transponder has been announced for commercial operation. Also, compression techniques do not affect the satellite design. Instead they reduce the amount of transponder capacity required and thereby lower the cost of transmission.

Subcarriers along with the video signal offer the potential for simultaneous foreign language translation as well as special services such as data, audio, and closed-captioning for the hearing impaired. Technology should and can make educational programming available to all regardless of their handicap.

VSATS (very small aperture terminals) are one of the fastest growing applications of satellite technology. Hundreds of business networks employ VSAT systems to handle data, audio and video transmission with two-way capability among several sites within an organization. Most of these services are provided on Ku-band satellites. This being the case, there will continue to be increased competition between the business and education sectors for access to the already limited supply of Ku-band transponders.

Financial Considerations

Depending upon the design configuration, a communication satellite can cost between $50 and $75 million. The launch vehicle required to place the satellite into orbit is also priced in the $50 to $75 million range. Insurance to replace both the satellite and the rocket in the event of a launch failure or some other anomaly would cost as much as 20% of the combined cost of the satellite and launch vehicle. Total space segment costs are estimated to be:

1 Satellite @ $75M	$75 million
1 Launches @ 75M	75
Subtotal	150
Insurance @ 20%	30
Total	$180 million

Some experts believe it is prudent to purchase two satellites and launch services in the event of a catastrophic failure of one, thus reducing the time to replace the 'ost satellite to only a few months. Such a plan obviously would double the cost.

Total system cost must also consider the cost of the ground segment, that is the size and cost of the thousands of earth stations to be used for satellite reception. It was noted earlier that to put more power on the satellite would reduce the antenna size and consequently its cost. When several thousands of earth stations are involved, this is always a beneficial trade-off even if the space segment costs rise. They will always be offset by the reduction in ground segment costs.

The KET study identified 20 program providers which will purchase more than 75,000 hours of transponder time in the 1990-91 school year. These agencies represent only about eighteen percent of the purchasers of satellite time. Although we could not confirm their total expenditures, it is plausible to assume that the total market is in excess of $50 million annually which is more than enough to pay for a satellite in about seven years including the annual cost of maintaining it.

Summary of Technical Findings

1. The universe of users of satellites to receive educational programming is rather large, at over 55,000 receive sites and growing.
2. Both C and Ku-band frequencies are employed.
3. There is a shortage of available transponder capacity at the times required. This is especially true in the Ku-band.
4. Educational institutions cannot effectively compete with private business for transponder time.
5. There is a trend to put more power on the satellite at both C and Ku-bands.
6. Digital video compression techniques are an effective way to deliver multiple programs on a single transponder.
7. To service the existing universe of earth stations, a satellite should operate in the Fixed Satellite Service. Broadcast Satellite Service should not be ruled out, but should only be considered to augment service delivery in the foreseeable future.
8. Some measures should be taken to aggregate educational program providers to more effectively obtain satellite capacity.

4. GOVERNANCE AND MANAGEMENT ISSUES

Ownership of the Satellite

Ownership of an education satellite is a matter of great importance to both federal and state policymakers. There are three options for securing a satellite for education purposes:

1. acquire a Federal Communications Commission (FCC) license to an orbital slot and purchase a satellite to fill it;
2. acquire a license to an orbital slot and contract with a vendor to provide a satellite on a lease basis; or
3. let a vendor acquire the license to an orbital slot and provide the satellite on a lease arrangement.

The first option is ideal from a control standpoint, but it may not be the most feasible initially. The design, construction and launch of a satellite is costly and requires at least three years to complete. It is a capital intensive venture that requires considerable up front investment before the satellite is in orbit and useable. Financing a project like this from design to launch would be difficult. Since the need for an education satellite is immediate and growing, one of the other options may be more viable for the near term.

Under the second option one could acquire an orbital slot and then contract with another party to build, launch *and privately finance* a satellite. The advantage to this approach is that it provides more flexibility in financing the project. However, there still remains the long application process required by the FCC. This option will take some time to pursue, but it could avoid even longer delays associated with financing or construction. It also ensures celestial space will be available even if there is a change in satellite vendor.

The third option presents the quickest route to securing access to a satellite for education. The rights to an existing inflight satellite can be secured either by outright purchase or by leasing all or a portion of its transponders. An existing owner of the satellite already has an FCC license for an orbital slot and an operational spacecraft. Such an approach avoids the lengthy process of securing rights to an orbital slot and the time required to design, construct and launch a new satellite. Also there is no risk of losing the satellite at launch.

The third option does have some problems. One reason for having an education satellite is to eliminate the need for repeated reorientation of ground antennae. The licensee is in the best position to maintain its orbital slot. Also, finding an existing satellite that is properly configured could be a problem.

Given the time required to secure a new satellite it might be prudent to get started with the "best fit" available now and design a better replacement to come on-line three to five years down the road. However, since an orbital slot belongs to the owner of a satellite, a later change in satellite vendor could require every uplink and downlink to change orientation to a different orbit. It is conceivable that a satellite owner might be willing to transfer one of its orbital slots as part of a contract to provide the satellite hardware, but this option probably is not a long term solution. At the very least policymakers should seek to have several hybrid orbital slots reserved by the FCC for educational purposes. The option of direct or second party ownership of the satellites then remains open but long term stability is gained for the ground segment of the system.

Governance of the System

The education satellite system is to be a telecommunications "pipeline" available to educational institutions for instructional purposes. The primary mission of the organization governing the satellite system is to ensure effective, equitable and efficient use of this public resource at a reasonable cost to its users. Designing an appropriate structure for governing the system is a matter of determining who should control what decisons. The decisions to be controlled in this instance would seem to be these:

1. The price of satellite time;
2. Schedules and priorities for satellite time;
3. Equitable access to the satellite;
4. Budget, contracts and debt;
5. Ownership of assets;
6. Acquisition and design (configuration, capacity, band, etc.) of satellites;
7. Expansion, dissolution or sale of the system; and
8. Operational policies and procedures of the organization.

Other matters such as encouraging greater use of the satellites, monitoring changes in technology, and anticipating future needs are more appropriate for the organization's management rather than a governance body to deal with.

Governance of an organization generally falls to those who make up its membership or have the most financial interest in it. Many of the users of satellites to distribute instructional programming are educational television stations which operate under a state charter or under the auspices of an educational institution. There also are several nonprofit organizations which broker satellite-based instructional programs such as the Black College Satellite Network and the National Technological University. These agencies have a financial interest in the organization since the purchase of satellite time is a major program expense. More importantly, these are the agencies that will be expected to use an education satellite if it is developed.

Models for Governance

The EDSAT Institute examined many organizational models but this report addresses only those models which are considered feasible to implement. Central in the analysis was identifying an organizational structure which could both serve the interests of those who will use the system and those who will invest in it. Four possible models are discussed here:

1. a national, non-federal agency responsible for all governance functions;
2. a new or existing interstate compact organization;
3. a multistate education telecommunications

"cooperative;" or

4. a "COMSAT/INTELSAT" type structure with membership under the control of user governments and/or educational agencies.

Each model is first discussed in general terms followed by a discussion of issues related to control, membership, and funding. Of course, it is possible to modify any of these models to meet specific concerns the organizing parties may have.

(1.) A National Non-federal Agency

One model is to create by Congressional action a national nonprofit organization dedicated to providing satellite communication services to educational agencies nationwide. The chartered organization is public but not governmental in nature. Although operating under a federal charter, it would not be a federal agency. The National Red Cross and the Boy Scouts of America are examples of federally chartered national organizations. The charter would provide for the creation, structure, governance and mission of the organization. It would operate much like a business entity except it has no stockholders and pays no dividends.

Control: An organization of this type is a public corporation that operates at the national level. It is self-governed by a board of directors appointed in the manner specified in its charter. Neither the states nor the federal government have direct control of the agency unless they are given responsiblity for the appointment of its directorate. The agency management controls its assets and has the same fiduciary responsibility as any public agency. The amount of control users of the system have depends on whether they are represented on the board of directors.

Membership: The agency is an operating entity, not a membership organization. There are no dues or other membership type requirements. The agency functions as a service organization. Any educational institution or agency fitting the service definition in its charter can purchase transponder time on its satellites.

Funding: Initial financial support could come from federal or state appropriation, but the agency is expected to be self-supporting. Revenues for the agency are generated from the sale of transponder time on the satellites under its ownership or control. The charter grants the organization authority to enter into contracts, acquire debt, establish fees for services, and conduct any other business necessary to its efficient operation. Financing for its satellites and related land facilities can be secured through loans, gifts, grants and revenues from transponder sales.

(2.) A New or Existing Interstate Compact Organization

A second model is an interstate compact organization. The interstate compact is a legal instrument for the conduct of multistate intergovernmental activity of mutual interest and benefit. Organizations formed in this manner function as agencies of the participating states and, therefore, can be supported through direct appropriation of state funds. The compact must be ratified by the participating state legislatures and is codified in the state statutes. The terms of the compact are considered binding on each state. However, a compact organization does not have the "good faith and credit" of the member states so it must be responsible for its own instruments of debt.

A compact organization can operate in a manner similiar to a federally chartered agency except it is chartered by the states rather than the federal government. (See discussion below about federal approval of interstate compacts.) Therefore, all of the *functions* described for the previous model can also be performed by an interstate compact organization. A compact would have to be drafted and adopted by the states which desire to participate in the satellite system. There are several regional education compacts (Southern Regional Education Board and Western Interstate Commission on Higher Education) and one national compact forming the Education Commission of the States. These three interstate compacts can serve as precedents for creating an interstate compact to acquire and manage an educational satellite system.

The U.S. Constitution prohibits interstate compacts that tend to increase the political power in the states and to encroach on or interfere with the just supremacy of the United States. [See the U.S. Const. art. I, 10, cl. 1; Northeast Bancorp., Inc. v. Board of Governors of Federal Reserve, 472 U.S. 159 (1985); U.S. Steel Corp. v. Multistate Tax Commission, 434 U.S. 452 (1978).] However, states wishing to form such a compact may petition Congress for permission to do so. [See Texas v. New Mexico, 462 U.S. 554 (1983); New Hampshire v. Maine, 426 U.S. 363 (1976).] An express agreement among states is not a prerequisite to a finding that a constitutionally prohibited interstate compact exists; such a finding could be based on reciprocal legislation by two or more states effectuating the same purposes as a formal agreement. [See U.S. Steel Corp. v. Multistate Tax Commission, *supra*.]

Control: An interstate compact organization is under the direct control of the states which enter into it. Various methods have been used to govern a compact organization although some compacts are administered directly by officials of the member states. In this case, a governing board of some type would be needed to maintain oversight of the satellite system. In most instances the governing board of a compact agency is made up of gubernatorial appointees representing each member state although this can vary depending on the nature of the compact. Representation of various educational interests could be required if desired. Often state policymakers or officials are specifically named to the governing board of a compact organization, generally on a rotational basis if the compact involves more than several states. There is no federal government involvement other than initial congressional approval of the compact.

Membership: The members of a compact are governments. An act of the legislature is required for participation in an interstate compact. Eligible membership is defined in the compact which can be enlarged only by consent of the member states. In this instance, the membership could be all states and territories or it could be limited to those states which utilize the satellite system. In the latter case, "utilize" means uplink access to the satellite. The downlink signal is in the public domain and freely available to anyone with a receiving antenna.

Funding: An interstate organization is funded at least in part by appropriations from the member states. Appropriation requests often take the form of "dues" assessed against the member states according to some formula designed to allocate organizational costs in an equitable manner. Member states voluntarily contribute their dues but the compacts usually have some provision for withholding compact services or benefits from nonpaying members. The organization also may secure outside funding from gifts and grants. In certain instances it may charge for certain services, especially those provided to entities outside the membership states.

In this model the organization could function without a large dues structure by charging for use of the satellite. The rates for transponder time can be uniform for educational institutions in the member states but set at a level sufficient to cover all organizational expenses. The organization underwrites the cost of securing and maintaining the satellite system from these and other revenues. Transponder time not used by the member states could be sold at appropriate rates to educational institutions in nonmember states as "occasional users" and at commercial rates to all other buyers. The organization should be financially self-sufficient.

(3.) A Multistate Telecommunications "Cooperative"

The formation of a multistate telecommunications "cooperative" is a less cumbersome model than the interstate compact organization. All education agencies which purchase satellite time can form a cooperative organization to acquire and manage a satellite system on their behalf. The cooperative is a not-for-profit business organization which provides goods and services to its members at below market rates. In the model here, the cooperative provides satellite communication services to its members. The cooperative is created to acquire, finance and manage one or more satellites for exclusive use of the members.

Control: A cooperative is under the direct control of the members. In this model the users of satellites would control the organization rather than political officials. The cooperative is a business organization and is structured as such. Management is selected and supervised by an elected board of directors. Policies of the cooperative are established by the directors and approved by the membership. Many of the cooperatives have strict operating procedures implemented by bylaw provisions that: (1) define membership eligibility standards; (2) establish democratic procedures for selecting and electing directors to ensure control by active members; and (3) prohibit conflicts of interest. This model probably provides the best opportunity for direct control over the system by its users.

Membership: Membership in the cooperative probably would consist of educational agencies which originate satellite-based instructional programming. Membership would be voluntary and could include organizations which are not governmental in nature such as private nonprofit educational institutions and television networks. However, membership in the cooperative could be a prerequisite to uplink access to the satellites in the system.

Funding: A cooperative is created to provide specific goods or services for the benefit of its members. The members support the cooperative by purchasing the goods and services it provides. In this case the members can underwrite the cost of acquiring, financing and managing the satellite system through payments for satellite time purchased from the cooperative. Cooperatives are expected to be self-sustaining.

(4.) The COMSAT/INTELSAT Model

In many ways states behave like sovereign political bodies and find it difficult to enter into cooperative ventures. We examined the interstate compact as one model for interstate cooperation. The COMSAT/INTELSAT structure might be another model. It combines some of the features in the interstate compact and cooperative models already discussed.

INTELSAT is a multi-national cooperative created in 1964 when 12 nations signed an Agreement Establishing Interim Arrangements for a Global Commercial Communications Satellite System. Presently some 119 nations are signatories to the agreements establishing and governing INTELSAT. INTELSAT's purpose is to own and operate a global system of communications satellites to serve the entire world. One of the main reasons for forming the international cooperative was the recognition that it would be difficult to persuade other nations to yield some of their sovereignty to an international organization. The best way to do so would be to allow each nation to price the services purchased from INTELSAT as it sees fit.

Control: INTELSAT is governed by a Board of Governors having between 25 and 30 members. Presently there are 27 members of the Board of Governors. Most of the Governors are appointed by nations with the largest annual usage of INTELSAT's services; however, some Governors are selected by groups of nations. For example, all of the Caribbean nations are jointly represented on the Board and three groups of sub-Saharan African countries are represented on the Board. Each nation or group of nations designates its own representative to the Board. Governors serve one-year terms and the Board meets four times per year. The Board elects a chairman and vice chairman annually.

In addition to the Board, there are two governing "chambers": the "Meeting of Signatories," and the "Assembly of Parties." Each of these chambers meets once every two years to set policy for INTELSAT and provide guidance to the Board. The Signatories represent the commercial interests in INTELSAT. For example, the United States representative to the Signatories is COMSAT. The Parties represent the governmental aspect of INTELSAT. In the case of the United States the representative to the Assembly of Parties is the Department of State. COMSAT is advised by the State Department, Commerce Department, and Federal Communications Commission concerning matters of foreign policy and international trade coming before the Meeting of Signatories.

INTELSAT policies, programs, and plans are established primarily by consensus and coalition building. If a member nation seeks to increase its use significantly, it must negotiate the increase privately with other nations that might be willing to give up some of their allotted capacity. Daily operations of INTELSAT are controlled by an executive organ headed by a Director General.

Membership: The only requirements for membership in INTELSAT are that a nation be a member of the International Telecommunications Union and that it make its payments in a timely manner. Although each member nation's investment interest in INTELSAT is proportional to its use of the space segment, the minimum unit of ownership is a fraction of one per cent, worth approximately $750,000 U.S. A nation's use is calculated by the number of uplinks or downlinks that occur in that country during the last quarter of one year and the first quarter of the next year; in other words, satellite transmissions are viewed as having two components which are counted separately in determining a nation's use of the system.

Funding: INTELSAT funding derives from three sources: (1) periodic capital contributions by member nations for capital expenditures, e.g., procuring a new satellite; (2) periodic assessments made against members for operations and maintenance expenses; and (3) payment by members and non-member customers for use of services. The first two categories of assessments are determined in proportion to each member nation's annual usage of INTELSAT's services. Members that do not pay their assessments in a timely manner are placed on a list distributed to the Board; the ultimate sanction for nonpayment is expulsion from INTELSAT. Members generally are conscientious about making their payments in a timely fashion.

Should such a model be employed by the states, some modification in the INTELSAT structure and operations is probably necessary. The states and territories could create a multi-layered structure in which there is a Board of Governors representing the political and policy interests of the member states and territories which sets the major policies governing the system. An "intelsat" organization, with its own Board of Directors, could manage the system according to the policies established by the Board of Governors. The Board of Governors would be a kind of "holding company" and the "intelsat" would be one of its "operating companies." Under this model the Board of Governors could have a broader mission with other operations associated with satellite-based instruction under its control.

The Technical Management of Satellites

Creating and managing a public domain satellite system requires a capacity to own and operate the technical infrastructure associated with space technology. The design, construction, launch and daily maintenance of the spacecraft are highly technical responsibilities beyond anything states or educational agencies have attempted up to now. These responsibilities can be performed by an existing governmental agency at the federal level, a private sector space and communications company, or a new multistate agency created for this purpose. Ideally the organization responsible for the business and technical management of the satellite system should have long experience in this business. The only federal agencies qualified to perform these functions are the National Aeronautical and Space Administration (NASA) and the Department of Defense.

Although the Department of Defense has an extensive satellite system worldwide, the space segment is dedicated to specific military missions and is not readily available for civilian use. The military might be able to donate one or more of its launched or unlaunched satellites for this purpose, but it is inappropriate for a military agency to manage the technical and business affairs of a civilian educational system. Therefore, the only other viable federal agency is NASA.

NASA has been given the mission to develop civilian utilization of space for "peaceful and scientific purposes." The Congress could give NASA responsibility for managing the technical aspects of an education satellite system. NASA has all the tracking stations and expertise required. In fact the satellites could be designed, constructed and launched by NASA contractors. However, NASA would be operating a telecommunications business in competition with the private sector, something the President and Congress might find politically undesirable.

If the states collectively create and finance the satellite system, with or without some federal financial assistance, they would no doubt wish to secure and retain to themselves ownership of the orbital slots and frequencies for the system. A multistate agency could contract with NASA or any private sector satellite telecommunications company for the provision and technical management of the satellites.

Direct contracting with a private sector space and communications company probably would be preferable, since NASA would rely on private contractors in any event. Such a course of action would permit participation in the project by the private sector on a competitive basis and probably result in lower cost to the states. If the states were to lease or purchase transponders, presumably the satellite owner would be responsible for operational aspects of the system.

5. FISCAL ISSUES

Financing the Organization

The education satellite system must become self-sufficient as soon as possible. The system provides a service which education agencies currently are purchasing on the commercial market. These expenditures, if aggregated, could be sufficient to underwrite the cost of the satellites, their technical management and the governing organization. The market forces that will play upon it are the same as found in the private sector. The organization must expect to respond in a similar manner.

The EDSAT Institute believes the system should not assume it would be subsidized beyond its initial years. Furthermore, it must be able to provide its services at a rate competitive with what is available in the commercial market. In order to do this, the organization may need to be structured in a way that permits it to sell excess capacity at commercial rates to non-educational purchasers. Obviously, this can have significant impact on its tax status as an organization and the tax status of any financing it may seek.

Financing the Satellite with Tax-Exempt Bonds

The cost of procuring and launching a satellite for educational purposes may be financable on either a tax-exempt or taxable basis. Because tax-exempt interest rates are significantly lower than taxable interest rates for comparable rated securities of comparable maturities, it would be beneficial if the satellite could be financed in whole or in part on a tax-exempt basis. If tax exempt financing is available to the governing body, then direct financing (and probably ownership) of a satellite might be a feasible approach. Federal and state laws regarding tax exemption are diverse and complex.

Generally, tax-exempt financing for a satellite can be accomplished if it is owned and used by state or local governmental bodies, by entities which are exempt from federal income tax under Section 501(c)(3) of the Internal Revenue Code of 1986, or by a combination thereof. Any ownership and interest in more than a *de minimis* amount of use of the satellite by for-profit entities or the federal government (or an agency or instrumentality thereof) will eliminate the tax-exempt bond option.

It is expected that significant use of the satellite will be made by 501(c)(3) educational institutions. Therefore, issues related to having these bonds treated as "qualified 501(c)(3) bonds" is important. With respect to qualified 501(c)(3) bonds, Section 147 of the Code provides that the average maturity of bonds can be no more than 120% of the average useful life of the assets being financed. Thus, if it is anticipated that the satellite will remain in orbit and be useful for ten years, the average life of the bonds should not exceed twelve years. This limitation does not apply if the bonds are governmental bonds.

A practical concern with respect to the issuance of these bonds is that state enabling legislation which authorizes the issuance of bonds for 501(c)(3) organizations typically requires bond proceeds to be used in the state in which the facility is located. Thus, any special launching facilities could be financed in the state in which those facilities were located. It may also be possible, given specific language in state enabling legislation, that although the satellite would not be located within the state of the financing, the financing could be done because it would benefit institutions located in the state.

Where the number of institutions using the satellite are located in a number of different states, it may be necessary to complete the financing through a number of composite offerings of separate bond issues. Furthermore, if the entity which owns the satellite is a 501(c)(3) organization, it may be possible to do the financing all in the state in which the 501(c)(3) entity is located, regardless of the fact that educational institutions around the country would also be taking advantage of the satellite, thus avoiding the need to do multiple composite transactions. Finally, if a new governmental entity is created, the enabling legislation could be drafted to solve these issues.

Whether bonds are issued on a taxable or tax-exempt basis, the key determination of their marketability is the credit behind the debt. In all likelihood, either the participating educational institutions will have to guaranty debt service or contracts analogous to take or pay contracts will need to be entered into and pledged to the bond trustee covering revenues from the use of the satellite.

Another issue which could arise in the context of marketing of the bonds is the coverage of interest payments until the satellite is operational and generating revenues. Typically, bond proceeds have to be expended within three years from the date of issue of the bonds, and the bonds can be sized to include the amount of interest owed on the bonds during the construction or payment period. It needs to be determined in connection with the feasibility of the economics of issuing the bonds as to how long it will be until the satellite generates sufficient revenues to cover its debt service.

The entity owning the satellite will need to be either a 501(c)(3) organization or a state or local governmental entity to take advantage of tax-exempt financing. Furthermore, to the extent there would be more than a *de minimis* amount of usage by for-profit entities, the financing could not be done on a tax-exempt basis. To the extent that use of the satellite was limited to public schools and universities, then more liberal tax-exempt bond rules would apply.

There are no specific limitations on the amount of loans that a 501(c)(3) organization may have outstanding. However, under Code 514, an exempt organization is required to include a fraction of income received from any debt-financed property in its unrelated business taxable income. However, the term "debt-financed property" does not include property acquired with borrowed funds if "substantially all the use of ... [the property] is substantially related ... to the exercise or performance by such organization of its charitable, educational, or other purpose or function constituting the basis for its exemption." IRC 514(b)(1)(A)(i).

Other Methods of Financing a Satellite

There may be an important role for the federal government in financing an education satellite. The Congress could make an appropriation for the cost of design, construction and launch of the satellite and then turn it over to the governing body. Such a scenario might be more likely if the states were to pick up a major portion of the cost. However, present fiscal and military circumstances would indicate that such direct financial support is unlikely in the near term. The federal government could underwrite the bonds issued by the governing body which would give them marketability similar to other federally guaranteed financial paper. However, such securities are not tax exempt. Finally, the federal government could donate an existing inflight or replacement NASA or military satellite to the governing body. This would require no new appropriation or delay in implementing the project.

On the private sector side, the organization could seek a satellite vendor willing to finance, build and launch the satellite on a guaranteed lease-back basis. A relatively stable revenue stream must be established first, but this might be a feasible approach in the outlying years.

6. GENERAL OBSERVATIONS

Some working group participants expressed concerns about various aspects of televised instruction such as program quality, teacher certification problems and improvement in the ability of teachers and students to interact. Although these are important issues, the proposal presented to President Bush by Governor Wilkinson focused only on problems associated with the space segment of distance learning. Therefore, the EDSAT Institute has confined this analysis to issues associated with the satellite system itself and not with the programming which it might carry.

Another concern of the participants was the amount of control, if any, the body which controls the satellite should have over the agencies which use it. The EDSAT Institute has taken the position that it is *inappropriate* for the organization which controls the satellite to control programming content or the terrestrial transmission and reception facilities of the educational agencies which use the satellite. Therefore, the governance discussion focused only on the kind of structure which can best ensure the equitable, efficient and effective management of the space segment of a satellite-based telecommunications system dedicated to instruction.

The analysis did not include using either the Corporation for Public Broadcasting CPB) or the Public Broadcasting Service (PBS) as candidates for governing or managing the satellite system. The Corporation for Public Broadcasting is a D.C. nonprofit corporation, the creation of which was authorized by Congress in the Public Broadcasting Act of 1967. CPB was intended by Congress to foster the development of public radio and television. CPB's active participation in the pursuit of these goals is checked, however, by the reluctance of Congress to allow it any control over broadcast operations or program content.

Specifically, CPB is prohibited from owning or operating, among other things, "any TV or radio broadcast station, system or network ... interconnection system ... public telecommunications entity, system, or network," and from producing programs. Its function is thus largely limited to extending grants to entities not constrained by these prohibitions. It apportions these grants to public television and radio stations and producers of non-commercial programs through an elaborate process prescribed by Congress.

CPB is endowed by Congress with a "Public Broadcasting Fund" administered by the Secretary of the Treasury. Congress enacts authorizing legislation for the Fund several years in advance. The amount available to CPB is also linked to the amount of funds raised by the entities CPB supports. A "Satellite Interconnection Fund" has also been established. The amount of $200 million has been authorized to the Satellite Interconnection Fund for 1991. Presently, CPB is using these funds to purchase transponders for use by the Public Broadcasting Service.

The Public Broadcasting Service (PBS) is one beneficiary of CPB grants. It, too, is a D.C. nonprofit corporation, incorporated in 1969. As such, it has 338 public television stations as "members." PBS is substantially supported by funds from these station members and receives only a small percent of its funds directly from CPB. These member stations, however, are financed by CPB for approximately 20% of their funds; the rest is provided mostly by private sources and state and local governments.

The statutory mission and constraints placed upon these two federal agencies do not provide the structure for the governance and technical management of a satellite system. However, if the federal government were to assume full responsibility for the system, including purchase of the satellites, then it would be reasonable for the Congress to consider granting either CPB or PBS responsibility for managing a federal satellite system. All information available to the EDSAT Institute at the time of this analysis indicated little likelihood that either the Congress or the President were inclined to support a federally funded system at the present time. Therefore, this approach was not considered feasible at this time.

The matter of PBS using a satellite system developed by the states was considered and discussed with the participants of the working groups. It was the consensus that such a decision was PBS's to make, but there was no reason for not making its participation part of any organizational structure that is created. In fact it is probably highly desirable. Present contractual relationships with AT&T for transponders on its new satellite might delay such co-location unless AT&T were to win the contract to provide a satellite for the state consortium. The AT&T contract with PBS might be renegotiable under such circumstances.

The National Telecommunications and Information Administration (NTIA) can serve an important role in chanelling federal grant funds to a satellite system. Congress could use NTIA as the vehicle for financing part of the cost of a satellite procurement negotiated by the governing body of the system. It can assist with planning for future developments and provide matching funds to educational institutions which utilize the system. However, it was not considered an appropriate agency for the governance or technical management of the satellite system.

The U.S. Department of Education, like NTIA, can be an important player by providing research and information on the use of satellite technology for instructional purposes. However, it is not an appropriate agency, either by mission or experience, to operate a satellite system even though the system is dedicated to educational purposes.

A final word is addressed to the importance of the private sector in this project. Many of the satellite telecommunications companies had representatives at various meetings of the working groups. Their knowledge and the information they provided were very helpful. The satellite industry has shown a strong interest in forging a partnership in this project. The idea of a for-profit organization created to develop this system was given thoughtful consideration but ultimate was rejected because of concerns from educators who wanted control of the system to be in public hands.

The EDSAT Institute is very cognizant of the concerns that are raised by the private sector when government seeks to compete with business and commerce for goods and services. However, we believe that the proposals offered here provide ample opportunity for private participation. Under every scenario, the private sector will at the very least be called upon to build and launch the satellites that make up the system. Most likely the private sector will provide the technical maintenance of the satellites once in orbit. Even private financing may be possible. It is expected that every element will be open to competitive procurement. The only aspect of the project which will be kept public is the governance of the system. A public investment in the system almost dictates public ownership and governance.

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